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(54) **Improvements relating to control data arrays**

Verbesserungen in Steuerdatenfeldern von Bildelementen

Améliorations relatives à des champs de données pour le contrôle d'éléments d'image

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Description

The invention relates to methods and apparatus for generating an array of control data, the array having a number of pixels each of which corresponds to a respective pixel in an image.

Such control data arrays are commonly termed masks and find wide use in image processing systems. For example, in page layout they may define the areas and positions occupied by the features in the page, as well as the area of each image to be included. In image retouching, or colour correction they may define which pixels of an image are to be modified. In electronic paint systems they may represent the density of the spray from an air brush. In design systems they may indicate the density gradation of a vignette pattern or shadow region.

Masks can be conveniently classified into two types: hard and soft. Hard masks have 1 bit per pixel. Their purpose is to separate the pixels of an image into two classes, one class to be processed in a certain way and the other to be processed in a different way. Soft masks, or "mattes", have multiple (usually 8) bits per pixel. They specify for each pixel a density value, which may represent the transparency (or opacity) of the pixel for a mixing operation. Into the latter category also fall soft-edged masks, having a hard interior but a graduated edge. These are typically used for "anti-aliased" compositing of curved shapes in computer graphics applications.

The use of masks simplifies both the operation and the software design of a product. For the operator the advantages are that fewer items of information need to be kept in mind at any one time. He can concentrate first on making the mask, using a variety of electronic "tools" as appropriate, then on using it to control the scope of some operation, such as image retouching. Similarly the software designer can create one set of routines for making and manipulating masks, and another for the transforms on images or pages.

The existence of a separate mask facilitates the design of hardware for the combination of two or more images for display on a video monitor. In the case of a hard mask, binary pixel values read from the mask store can be used to control a video-rate switch between the corresponding pixels of source images read synchronously from separate image stores. In the case of a soft mask, 8-bit pixel mask pixel values read from the mask store can be used to control a video-rate mixer that adds proportions of each of the source image pixels. Such arrangements are disclosed in EP-A-0089174 (equivalent US Patent 4,617,592) and EP-A-0344976 (equivalent US Patent 4954912).

Masks can be generated conventionally in a number of ways. In the case of a hard mask, the operator might outline and fill an area of an image which is to be one class resulting in all the corresponding control pixels being coded with a binary "1" while the remainder are coded with a binary "0". In another method, a colour selective technique can be used to define a hard mask. In this technique each pixel of the source image is checked to determine whether the individual colour values (such as red, green, blue) fall into specified ranges. The true/false results are combined logically to give a final true or false (1 or 0) value for the corresponding mask pixel. The mask can then be displayed superimposed over the image.

As an example, the algorithm used in the Crosfield Studio 800 system allows up to four classes of source colour to be defined. Each class consists of a range of values for one or more of the CMYK (cyan, magenta, yellow, black) inks (defaulting to 0-100% if not defined). A pixel of the source image is considered to be a member of a class if all its colour components fall within the specified CMYK ranges (AND = logical intersection). A mask pixel is set if the corresponding image pixel lies in one or more of the classes (OR = logical union),

i.e. if (C1 AND M1 AND Y1 AND K1)
OR (C2 AND M2 AND Y2 AND K2)
OR (C3 AND M3 AND Y3 AND K3)
OR (C4 AND M4 AND Y4 AND K4) is TRUE.

The ranges C1, M1, etc are any arbitrary sets of values in each colour. Normally each range would represent one contiguous set of values, such as $40 \le C \le 60$, but non-contiguous sets are also allowed.

Although the colour selective masking method described above gives usable colour selective masks, it suffers from several limitations:

1. The limits define a cuboid volume in colour space which is not always as selective as necessary;
2. It gives only a true/false selection, resulting in a binary or hard mask;
3. It does not perform well on translucent or reflective subjects where the background and foreground colours are mixed;
4. The masks are affected by noise, resulting in unwanted "pin-holes" and ragged edges; and
5. It can be slow in implementation, resulting in frustrating delays for an operation that should ideally be interactive.

US-A-4878178 discloses an image processing device in which data defining the content of a pixel is made up of six binary digits defining R, G and B components and two bits defining label information. The label information is used to select particular pixels for colour modification.

EP-A-0159691 describe a colour image display system using a histogram technique to determine colours to be

displayed.

In accordance with one aspect of the present invention, a method of generating an array of control data for use as a mask for processing an image, the array having a number of pixels each of which corresponds to a respective pixel in an image, the method comprising selecting at least one target colour, and then for each control data array pixel generating a control value in accordance with a predetermined algorithm which defines the control value as a function of the corresponding image pixel colour components and the corresponding colour component(s) of the target colour (s), the function defining an ellipsoidal region in the colour space of the colour components wherein the generated control values can be ordered on a scale of at least three value classes to define a multi-bit mask and wherein the step of defining the target colour comprises specifying an area of interest within the image; constructing a histogram of pixel values within the specified area of interest and determining from the histogram the median and given percentile points for each colour component, and thereby providing the target colour weighting and spread coefficients for the predetermined algorithm.

In accordance with a second aspect of the present invention, apparatus for generating an array of control data for use as a mask for processing an image, the array having a number of pixels each of which corresponds to a respective pixel in an image, the apparatus comprising a first store for storing the image data; a second store for storing the control data; and processing means which, for each control data array pixel generates and stores in the second store a control value in accordance with a predetermined algorithm which defines the control value as a function of the corresponding image pixel colour components and the corresponding colour component(s) of at least one preselected target colour, wherein the generated control values can be ordered on a scale of at least three value classes to define a multi-bit mask characterised in that the function performed by the predetermined algorithm defines an ellipsoidal region in the colour space of the colour components; and in that the processing means preselects a target colour following the specification of an area of interest within the image by constructing a histogram of pixel values within the specified area of interest and determining from the histogram the median and given percentile points for each colour component, and thereby providing the target colour weighting and spread coefficients for the predetermined algorithm.

This invention improves upon the previous colour selective masking technique by obtaining a measure of the proximity of the colour coordinates of an image pixel to some target point in colour space, rather than simply making a binary decision about each colour component independently.

In one embodiment, the predetermined algorithm can define the control value as representing a function of the Euclidean distance in colour space between the image pixel colour and the target colour. For example, the predetermined algorithm may have the form:

$$D = \sqrt{(a(C-C_T)^2 + b(M-M_T)^2 + c(Y-Y_T)^2 + d(K-K_T)^2)} \tag{1}$$

where

C_T, M_T, Y_T, and K_T are the colour component values of the target colour,
C, M, Y, K, are the colour component values of the image pixel, and
a, b, c, and d are weighting coefficients.

Although equation 1 defines the control value in terms of all four colour component values, this is not essential and only one or some of the colour component values could be used. It should also be understood that any other suitable colour space could be used in place of CMYK, which is customary for printing applications. For example, in the frame stores for video display monitors pixels would typically be represented by red, green and blue colour components. In broadcast television, colour is encoded differently for transmission, such as the YIQ signals in the NTSC system. In yet other applications, such as paint and dye formulation, the CIE system is commonly used with LAB or LUV coordinates. The present invention applies without loss of generality to all of these, and other, colour spaces.

For some purposes a simple distance metric, as described above, is not sufficient. In order to generate a matte proportional to the "blueness" of the image, for example, a 2-D Gaussian distribution, centred on the target colour of blue might be more appropriate. This could be formulated as the product of two 1-D Gaussians:

$$D = f(C,M) = a \exp[-b(C-C_T)^2] \exp[-c(M-M_T)^2] \tag{2}$$

where

a is a normalising factor

and b, c govern the widths of the distributions for C,M.

Such functions can easily be extended to three or more colour coordinates as necessary. They are set out here in two colours only to facilitate visualisation. Instead of a Gaussian, an inverse power law might prove to be more useful having the general form:

$$D = g(C,M) = \frac{a}{[C-C_T]^b+1} \cdot \frac{1}{[M-M_T]^c+1}$$

One use for such functions could be in image retouching, for example to change all pixels of the target colour to another colour (e.g. blue to green) and to change pixels of nearby colours by a proportional amount. The density matte value a at each pixel, normalised to the range [0-1], could then be used to control the blending of the image with the new colour, for example by linear combination of each colour component:

$$\text{Modified pixel} = (1\text{-}a) \times \text{Old pixel} + a \times \text{New colour} \tag{4}$$

A further refinement of the technique can be made if the operator specifies not only the object (foreground) colour but also the background colour. The matte is then calculated in such a way that it takes high values for colours near the foreground target, low values for colours near the background target, and a medium value for all other colours. For example, using the Gaussian functions given in equation (2), the composite function could be:

$$f.(C,M) = f_F(C,M) - f_B(C,M) + f_0 \tag{5}$$

where

f_F is the foreground function
f_B is the background function
and f_0 is a constant

The effect of this function is to have a maximum value at the foreground target colour, a minimum value at the background target colour and intermediate values elsewhere.

In some cases the function may include a thresholding step in which an intermediate control value is compared with a threshold to generate a final, binary control value or the final value may be generated from an intermediate value and tone curves leading to a soft mask.

In some circumstances, it has been found that selecting pixels with colours close to the target pixels can have surprising results. For example, an object which may appear generally red may actually contain a number of tints from blacks in deep shadows, intense reds where the object reflects internally, pinks and whites for highlights, and so on. These tints are not necessarily the nearest to the target colour in the first colour space that is available, but span a range extending from the pure colour towards both white and black.

We therefore propose an additional, preliminary, step in which the initial colour components defining the image in a first colour space are transformed into a second or subsequent colour space from which the control values can be determined. For example, in one case of particular interest the first colour space is transformed so that the colour components defining the central locus of the target colour range lie along the major axis of the second colour space, with the other two axes being perpendicular to the first axis and to each other. From this second colour space it is easy to derive the control values corresponding to each pixel of the image.

The processing means may be implemented in a suitably programmed computer or in a hardware form. In the latter case, for example, in order to implement the algorithm defining equation (1) above, four look-up tables are provided each of which defines a function of the form $X_i = (i-Y_T)^2/N^2$

where Y_T is a target colour component value and N is a scaling coefficient chosen so that the required amount of sensitivity for that colour component is achieved, outputs from the look-up tables being fed to adders which generate the sum of the outputs, the output from the adders being fed to a fifth look-up table which reduces the accuracy back to eight bits. This look-up table is commonly loaded with a linear or square root function.

Other configuruations are possible as will be described below.

Some examples of methods and apparatus according to the invention will now be described with reference to the

accompanying drawings, in which:-

Figure 1 illustrates graphically the relationship between a mask generated using a conventional colour selective technique and a mask generated by a method according to the invention;
Figure 2 illustrates the form of a weighted density function;
Figure 3 illustrates the form of a function which discriminates between foreground and background colour domains;
Figure 4 illustrates one example of a colour selective mask generation circuit;
Figure 5 illustrates a second example of a colour selective mask generation circuit;
Figures 6A and 6B illustrate an image and a colour component histogram respectively during the generation of a target colour;
Figures 7A-7E illustrate different stages in a method for preparing colour component data; and,
Figure 8 is a schematic block diagram of apparatus for performing the steps illustrated in Figure 7.

Figure 1 illustrates a distance function in colour space, reduced to two-dimensions for simplicity, where the target colour has components C_T and M_T and an elliptical contour 1 results from calculating the distance function:

$$D = \sqrt{(a(C-C_T)^2 + b(M-M_T)^2)} \qquad (6)$$

The rectangular contour 2 which is shown illustrates, for comparison purposes, the effect of a conventional thresholding technique which simply makes a true/false decision depending upon whether or not C and M are within a range of values spanning the target colour. In this conventional case, any combination of C and M within the rectangle result in a mask value 1, anywhere outside the rectangle result in a mask value 0.

In this example of the invention, the region in colour space can be restricted to an ellipse so that points that were included in the corners of the rectangle will now be excluded. The reduction in area is to fAB for the ellipse from 4AB for the rectangle, a constant ratio of f/4 = 0.79. In three dimensions the volume ratio of ellipsoid to cuboid is f/6 = 0.52. Thus the selectivity of the ellipsoid is almost double that of the cuboid.

Figure 2 illustrates the form of the function defined by equation (2) above with the Z-axis representing the magnitude of the function.

Figure 3 illustrates an example of the function defined in equation (5) above in two dimensions.

Figure 4 illustrates a first embodiment of a hardware arrangement for implementing the method. In this example, respective colour components C, M, Y and K of pixel data in the image store 100 are fed to four look-up tables 3-6 (L1-L4), each having 256 addressable entries with an 8-bit data value stored at each entry. The outputs from the look-up tables 3, 4 are fed to an adder 7 while the outputs from the look-up tables 5, 6 are fed to an adder 8. The 9-bit outputs from the adders 7, 8 are fed to an adder 9 whose 10-bit output is used to address a look-up table 10 having 1024 entries, each containing an 8-bit mask value, which is stored in the corresponding pixel location in mask store 17.

In the simplest case, the look-up tables could be loaded as follows:

L1	$X_i = (i-C_T)^2/N^2$	i = (0..255)
L2	$X_i = (i-M_T)^2/N^2$	i = (0..255)
L3	$X_i = (i-Y_T)^2/N^2$	i = (0..255)
L4	$X_i = (i-K_T)^2/N^2$	i = (0..255)
L5	$X_i = 8\sqrt{i}$	i = (0..1023)

The scaling coefficient N is chosen so that the required amount of sensitivity is achieved. Out-of-range values are limited to 255. For example, N=1 concentrates attention on the narrow range $C_T \pm 16$ whereas N=8 broadens the useful range to $C_T \pm 128$. Differing values of N for each table give the ellipsoidal regions, i.e. differing sensitivities for the different colour primaries.

The multiplicative functions given by equations (2) and (3) can also be implemented by the circuit of Figure 4 by loading logarithms of the functions in the input tables and an antilogarithm in the output table:

L1 - L4	$X_i = a \cdot \log(f_N(i))$
L5	$X_i = \exp(i/a)$

Figure 5 illustrates an alternative circuit, which is functionally almost identical to the circuit in Figure 4. In this case, the colour component data C, M and Y, K are fed in pairs from the image store 1 to look-up tables 11, 12 (L10,L11)

each of which has dimensions 64K x 8. The outputs from the look-up tables 11, 12 are fed to a further look-up table 13 (L12) to generate the final 8 bit value for storage in the mask store 17. The advantage of this arrangement is that the adders are omitted allowing more complex two-dimensional functions to be represented (e.g. ellipses with rotated axes).

In operation, the user will first define the target colour. This may involve, for example, displaying the image (Fig. 6A) on a monitor and then defining regions in the image having the colour which it is desired to mask. In this example, a colour-selective mask for the boy's T-shirt is required so that the operator might circle two regions 14, 15 using a cursor or the like and then a further region 16 corresponding to an area which is not to be masked.

The computer then "plots" all the pixels within the contours 14-16 in colour space and constructs a histogram for the distribution within each colour coordinate as illustrated in Fig. 6B. This histogram is then analysed to determine the median and given percentile points (in this case 10% and 90%) in each colour channel as shown in Fig 6B. The mean is used to define the colour component values of the target colour as shown. For example, the spread coefficients are derived from the statistical spread, or scatter, of the sample points as indicated for example by the 10%ile and 90%ile points of the histogram. They are then used to determine the length of the semi-axes of the ellipse in Figure 1, ie. the dimensions of the region in colour space that contains the majority of the desired colours. Equation (1) could be expressed as:

$$D^2 = \frac{(C-C_T)^2}{x^2} + \frac{(M-M_T)^2}{y^2} + \frac{(Y-Y_T)^2}{z^2} \qquad (7)$$

where

$x = C_{90} - C_{10}$
$Y = M_{90} - C_{10}$
$Z = Y_{90} - Y_{10}$

The operator then instructs the computer to perform the appropriate algorithm as defined by the look-up tables of either the Figure 4 or Figure 5 circuit. The resultant mask is then stored in a store 17. To derive a hard (1-bit) mask for separating foreground and background regions of an image, the operator could subsequently apply a simple threshold operation to the 8-bit data in mask store 17, displaying pixels of the mask where the value exceeds the threshold level by a distinctive colour such as bright green. Interactive adjustment of the threshold level would allow the operator to use judgement as to the optimum setting.

As has been mentioned above, in some cases, it may be desirable to transform the colour components from one colour space to another before generating the colour-selective mask. The reason for this can be seen in Figure 7A where the probability contours of the range of colours in CMY colour space that can be seen in an object of a certain colour under different lighting conditions are shown in two dimensions. It can be seen that the central locus of these contours comprises a curve starting in the black corner, passing through the target colour, and then ending at the white point. In the invention, we wish to plot the three-dimensional distribution of all colours within a certain degree of fit from the target colour, for example by sampling pixels from one or more areas of the image. It would be expected that this Figure will extend in the light/dark directions due to the large variety of lighting conditions, but will be quite confined in the perpendicular (hue) directions since hue is relatively unchanged with variations in lighting conditions.

Ideally, one should transform the colour components to a second colour space that is based upon the perceptual colour attributes of lightness, colourfulness and hue (LCH), such as defined in the 1976 CIELUV Uniform Colour Space. Indeed, for applications where a high standard of colour fidelity must be maintained, such as image retouching and colour matching for print reproduction, use of such a colour space is essential. For making a mask, however, the quality criteria are less stringent and certain approximations can successfully be made.

We have simplified the transformation by observing that the major diagonal in the CMY "colour cube" runs from black to white and is a reasonable approximation to the true achromatic lightness axis. In order therefore to improve the colour-selective masking technique, in an initial step the amounts by which the colour component values (CMY) defining the target colour must be modified to move those values so as to lie on the major diagonal in the colour cube (Figure 7B) are determined and then these weights are stored in an initial section of a set of nine look-up tables 50-58 (Figure 8). The initial CMY values are thus applied to respective sets of three of the look-up tables 50-58 which in the first section will convert these colour components to new colour values C', M', Y', to define a set of elliptical contours aligned to the diagonal as shown in Figure 7B. The target point is now on the diagonal of the colour cube while the black and white points stay unchanged.

The actual transformation is conveniently performed by scaling by linear amounts above and below the target colour, ie. by fitting straight lines from the target colour to the white and black points respectively. This introduces a

geometric discontinuity at the target point, although in most instances this causes no visible discontinuity in the final mask. This discontinuity could be eliminated by fitting a higher order curve, such as a parabola, through the target to the white and black points.

In the next stage the axes of the colour cube are rotated so that the first new axis (X') lies along the diagonal of the colour cube and the other two (Y', Z') are perpendicular to it. This rotation results in the image being defined by new colour components X', Y', Z' with contours as shown in Figure 7C. The rotation is performed by a second section of each of the LUTs 50-58 and a corresponding set of three summation circuits 59-61. Typically, each LUT 50-58 will also add an offset.

Although a complex transform, such as defined by the 1976 CIELUV formulae, would give the optimum results, in practice a simple linear combination of the CMY primaries gives acceptable results:

$$\left.\begin{aligned} X' &= (C+M+Y)/3 \\ Y' &= (M-C)/2 \quad + \text{offset} \\ Z' &= (2Y-C-M)/4 + \text{offset} \end{aligned}\right\} \quad (8)$$

The X' axis approximates the lightness dimension in a perceptual colour space, and the Y', Z' axes approximate the opponent red-green and yellow-blue dimensions respectively.

In the next stage, the new axes are scaled by respective, different amounts, an origin shift is performed and the resulting component values are squared. This results in a series of circular contours (Figure 7D) and is performed by the look-up tables 62-64. The output values of these look-up tables 62-64 are reduced to eight bits and then fed to a summation circuit 65 and thence to an output look-up table 66 which may be loaded with a square-root or other function to derive the 8-bit mask value, in similar fashion to LUT 10 of Figure 4.

Although the above description of the transformation implemented by Figure 8 has assumed the first colour space to represent the printing ink colours CMY, other colour spaces could equally well be catered for by minor variants of the transformation. In particular, the RGB colour spaces used for phosphor display monitors or emulsion film scanners can be handled because the RGB coordinates are complementary to CMY and define the same "colour cube" as described above.

Claims

1. A method of generating an array of control data for use as a mask for processing an image, the array having a number of pixels each of which corresponds to a respective pixel in an image, the method comprising selecting at least one target colour, and then for each control data array pixel generating a control value in accordance with a predetermined algorithm which defines the control value as a function of the corresponding image pixel colour components and the corresponding colour component(s) of the target colour(s), the function defining an ellipsoidal region in the colour space of the colour components wherein the generated control values can be ordered on a scale of at least three value classes to define a multi-bit mask and wherein the step of defining the target colour comprises specifying an area of interest (14-16) within the image; constructing histograms of the colour components of the pixel values within the specified area of interest and determining from the histograms the median and given percentile points for each colour component, and thereby providing the target colour weighting and spread coefficients for the predetermined algorithm.

2. A method according to claim 1, wherein the predetermined algorithm defines the control value as representing a function of the Euclidean distance in colour space between the image pixel colour and the target colour.

3. A method according to claim 2, wherein the predetermined algorithm has the form

$$D = \sqrt{(a(C-C_T)^2 + b(M-M_T)^2 + C(Y-Y_T)^2 + d(K-K_T)^2)} \quad (1)$$

where

C_T, M_T, Y_T, and K_T are the colour component values of the target colour,
C, M, Y, K, are the colour component values of the image pixel, and

a, b, c, and d are weighting coefficients.

4. A method according to claim 1 or claim 2, wherein the predetermined algorithm has the form

$$D = f(C,M) = a \exp[-b(C-C_T)^2] \exp[-c(M-M_T)^2] \quad (2)$$

where

a is a normalising factor
and b, c govern the widths of the distributions for C,M.

5. A method according to claim 1 or claim 2, wherein the predetermined algorithm has the form

$$f.(C,M) = f_F(C,M) - f_B(C,M) + f_0 \quad (5)$$

where

f_F is the foreground function
f_B is the background function
and f_0 is a constant

6. A method according to any of the preceding claims, further comprising a preliminary step in which the initial colour components defining the image in a first colour space are transformed into a second or subsequent colour space from which the control values can be determined.

7. A method according to claim 6, wherein the first colour space is transformed so that the colour components defining the central locus of the target colour range lie along the major axis of the second colour space, with the other two axes being perpendicular to the first axis and to each other.

8. Apparatus for generating an array of control data for use as a mask for processing an image, the array having a number of pixels each of which corresponds to a respective pixel in an image, the apparatus comprising a first store for storing the image data; a second store for storing the control data; and processing means which, for each control data array pixel generates and stores in the second store a control value in accordance with a predetermined algorithm which defines the control value as a function of the corresponding image pixel colour components and the corresponding colour component(s) of at least one preselected target colour, wherein the generated control values can be ordered on a scale of at least three value classes to define a multi-bit mask; characterised in that the function performed by the predetermined algorithm defines an ellipsoidal region in the colour space of the colour components; and in that the processing means preselects a target colour following the specification of an area of interest within the image by constructing histograms of the colour components of the pixel values within the specified area of interest and determining from the histograms the median and given percentile points for each colour component, and thereby providing the target colour weighting and spread coefficients for the predetermined algorithm.

9. Apparatus according to claim 8, wherein the processing means comprises four look-up tables each of which defines a function of the form

$$X_i = (i-Y_T)^2/N^2$$

where Y_T is a target colour component value and N is a scaling coefficient chosen so that the required amount of sensitivity for that colour component is achieved, outputs from the look-up tables being fed to adders which generate the sum of the outputs, the output from the adders being fed to a fifth look-up table which reduces the accuracy back to eight bits.

Patentansprüche

1. Verfahren zum Erzeugen einer Gruppe von Steuerdaten zur Verwendung als Maske bei einer Bildverarbeitung, wobei die Gruppe eine Pixelzahl aufweist, von denen jede einem Bildpixel entspricht, mit folgenden Schritten: mindestens eine Zielfarbe wird ausgewählt und dann wird für jedes Steuerdaten-Gruppenpixel ein Steuerwert entsprechend einem vorbestimmten Algorithmus erzeugt, der den Steuerwert als eine Funktion der entsprechenden Bildpixel-Farbkomponenten und der entsprechenden Farbkomponente(n) der Zielfarbe(n) definiert, wobei die Funktion einen elliptischen Bereich im Farbraum der Farbkomponenten definiert, wobei die erzeugten Steuerwerte in einer Skala von mindestens drei Wertklassen geordnet werden, um eine Multibit-Maske zu definieren und wobei der Schritt zum Definieren der Zielfarbe das Spezifizieren eines Interessenbereichs (14-16) innerhalb des Bildes beinhaltet, Histogramme der Farbkomponenten der Pixelwerte in dem spezifizierten Interessenbereich konstruiert werden und aus den Histogrammen die mittleren und gegebenen prozentualen Punkte für jede Farbkomponente bestimmt werden und damit die Gewichtung der Zielfarbe und Verlauf-Koeffizienten für den vorbestimmten Algorithmus bereitgestellt werden.

2. Verfahren nach Anspruch 1, bei dem der vorbestimmte Algorithmus den Steuerwert so definiert, daß er eine Funktion der Euklid'schen Entfernung im Farbraum zwischen der Bildpixelfarbe und der Ziel farbe darstellt.

3. Verfahren nach Anspruch 2, bei dem der vorbestimmte Algorithmus folgende Form aufweist:

$$D = \sqrt{(a(C-C_T)^2 + b(M-M_T)^2 + c(Y-Y_T)^2 + d(K-K_t)^2)} \qquad (1)$$

wobei

C_T, M_T, Y_T und K_T die Farbkomponentenwerte der Zielfarbe sind,
C, M, Y, K die Farbkomponentenwerte der Bildpixel und
a, b, c, d die Gewichtungskoeffizienten.

4. Verfahren nach Anspruch 1 oder 2, bei dem der vorbestimmte Algorithmus folgende Form aufweist:

$$D = f(C,M) = a \exp[-b(C-C_T)^2] \exp[-c(M-M_T)^2] \qquad (2)$$

wobei

a ein Normalisierungsfaktor ist und
b, c die Breite für den Verlauf von C und M steuern.

5. Verfahren nach Anspruch 1 oder 2, bei dem der vorbestimmt Algorithmus folgende Form aufweist:

$$f*(C,M) = f_F(C,M) - f_B(C,M) - f_0 \qquad (3)$$

wobei

f_F die Vordergrundfunktion
f_B die Hintergrundfunktion und
f_0 eine Konstante ist.

6. Verfahren nach einem der vorhergehenden Ansprüche, bei dem ein vorhergehender Schritt vorgesehen ist, bei dem die anfänglichen, das Bild in einem ersten Farbraum definierenden Farbkomponenten in einen zweiten oder anschließenden Farbraum transformiert werden, aus dem die Steuerwerte bestimmt werden.

7. Verfahren nach Anspruch 6, bei dem der erste Farbraum derart transfortmiert wird, daß die Farbkomponenten, die die zentrale Ortskurve des Zielfarbenbereiches definieren, längs der größeren Achse des zweiten Farbraums liegen, wobei die beiden anderen Achsen rechtwinklig zur ersten Achse und zu sich selbst liegen.

8. Vorrichtung zum Erzeugen einer Gruppe von Steuerdaten zur Verwendung als Maske bei einer Bildverarbeitung. wobei die Gruppe eine Pixelanzahl hat, die jeweils einem jeweiligen Bildpixel entspricht, mit einem ersten Speicher zum Speichern der Bilddaten, einem zweiten Speicher zum Speichern der Steuerdaten und Prozessormitteln, die für jedes Steuerdaten-Gruppenpixel im zweiten Speicher einen Steuerwert gemäß einem vorbestimmten Algorithmus erzeugen und speichern der den Steuerwert als Funktion der entsprechenden Bildpixel-Farbkomponenten und der entsprechenden Farbkomponente(n) mindestens einer ausgewählten Zielfarbe definiert. wobei die erzeugten Steuerwerte auf einer Skala von mindestens drei Wertklassen geordnet werden, um eine Multibitmaske zu definieren, dadurch gekennzeichnet, daß die von dem Algorithmus ausgeführte Funktion einen elliptischen Bereich im Farbraum der Farbkomponenten definiert und daß die Prozessormittel nach der Spezifizierung des Interessenbereichs innerhalb des Bildes eine Zielfarbe auswählen, in dem Histogramme der Farbkomponenten der Pixelwerte innerhalb des spezifizierten Interessenbereichs erstellt werden und aus den Histogrammen die mittleren und gegebenen prozentualen Punkte für jede Farbkomponente bestimmt werden, und daß dadurch die Gewichtung und Verlaufskoeffizienten der Zielfarbe für den vorbestimmten Algorithmus vorgesehen werden.

9. Vorrichtung nach Anspruch 8, bei der die Prozessormittel vier Tabellenspeicher aufweisen, von denen jeder eine Funktion entsprechend

$$X_i = (i-Y_T)^2 / N^2 \text{ definiert,}$$

wobei Y_T ein Zielfarben-Komponentenwert und N ein Skalier-Koeffizient ist, der so ausgewählt ist, daß die erforderliche Größe der Sensitivität für jede Farbkomponente erzielt wird, wobei die Ausgangssignale der Tabellenspeicher zu Addierstufen geführt werden, die die Summe der Ausgangssignale erzeugen, wobei das Ausgangssignal der Addierstufen in einen fünften Tabellenspeicher geführt wird, der die Genauigkeit zurück auf 8 Bits reduziert.

Revendications

1. Procédé pour produire un champ de données de commande, à utiliser comme masque en vue de traiter une image, le champ présentant un nombre de pixels dont chacun correspond à un pixel correspondant d'une image, le procédé comportant la sélection d'au moins une couleur-cible et ensuite, pour chaque pixel du champ de données de commande, la production d'une valeur de commande, en accord avec un algorithme prédéterminé qui définit la valeur de commande en fonction des composantes chromatiques du pixel d'image correspondant et de la ou des composantes chromatiques correspondantes de la ou des couleurs-cible, la fonction définissant une région ellipsoïdale dans l'espace chromatique des composantes chromatiques, dans laquelle les valeur de commande produites peuvent être rangées sur une échelle d'au moins trois classes de valeurs pour définir un masque multibits, et dans lequel l'étape consistant à définir la couleur-cible comporte la définition d'une région de travail (14-16) dans l'image; la construction de l'histogramme des composantes chromatiques des valeurs de pixel situées dans la zone de travail spécifiée, et la détermination, à partir des histogrammes, de la médiane et de points de percentile donnés pour chaque composante chromatique, et ainsi fournir les coefficients de pondération et de dispersion de la couleur-cible, pour l'algorithme prédéterminé.

2. Procédé selon la revendication 1, dans lequel l'algorithme prédéterminé définit la valeur de commande comme représentant une fonction de distance Euclidienne dans l'espace chromatique entre la couleur du pixel d'image et la couleur-cible.

3. Procédé selon la revendication 2, dans lequel l'algorithme prédéterminé présente la forme

$$D = \sqrt{(a(C-C_T)^2 + b(M-M_T)^2 + c(Y-Y_T)^2 + d(K-K_T)^2)} \tag{1}$$

dans laquelle

C_T, M_T, Y_T et K_T sont les valeurs des composantes chromatiques de la couleur-cible,
C, M, Y, K sont les valeurs des composantes chromatiques du pixel d'image, et
a, b, c et d sont les coefficients de pondération.

4. Procédé selon la revendication 1 ou la revendication 2, dans lequel l'algorithme prédéterminé présente la forme

$$D = f(C,M) = a \exp[-b(C-C_T)^2] \exp[-c(M-M_T)^2] \qquad (2)$$

dans laquelle

a est un facteur de normalisation,
et b, c gouvernent la largeur des distributions de C,M.

5. Procédé selon la revendication 1 ou la revendication 2, dans lequel l'algorithme prédéterminé présente la forme

$$f.(C,M) = f_F(C,M) - f_B(C,M) + f_0 \qquad (5)$$

dans laquelle

f_F est la fonction d'avant-plan
f_B est la fonction d'arrière-plan
et f_0 est une constante.

6. Procédé selon l'une quelconque des revendications précédentes, qui comporte en outre une étape préliminaire dans laquelle les composantes chromatiques initiales qui définissent l'image dans un premier espace chromatique sont transformées dans un deuxième espace chromatique, ou espace chromatique suivant, à partir duquel les valeurs de commande peuvent être déterminées.

7. Procédé selon la revendication 6, dans lequel le premier espace chromatique est transformé de telle sorte que les composantes chromatiques définissant le lieu central de la plage de couleurs-cibles soient situées le long du grand axe du deuxième espace chromatique, les deux autres axes étant perpendiculaires au premier axe et l'un par rapport à l'autre.

8. Appareil pour produire un champ de données de commande à utiliser comme masque en vue du traitement d'une image, le champ présentant un nombre de pixels dont chacun correspond à un pixel correspondant d'une image, l'appareil comportant une première mémoire pour conserver les données d'images; une deuxième mémoire pour conserver les données de commande; et un moyen de traitement qui, pour chaque pixel du champ de données de commande, produit et conserve dans la deuxième mémoire une valeur de commande, en accord avec un algorithme prédéterminé qui définit la valeur de commande en fonction des composantes chromatiques du pixel d'image correspondant et de la ou des composantes chromatiques correspondantes d'au moins une couleur-cible présélectionnée, dans lequel les valeurs de commande produites peuvent être rangées sur une échelle d'au moins trois classes de valeurs pour définir un masque multibits; caractérisé en ce que la fonction réalisée par l'algorithme prédéterminé définit une région ellipsoïdale dans l'espace chromatique des composantes chromatiques; et en ce que le moyen de traitement présélectionne une couleur-cible après la définition d'une zone de travail dans l'image, en construisant des histogrammes des composantes chromatiques des valeurs de pixel dans la zone de travail définie, et en déterminant à partir des histogrammes la médiane et des points de percentile donnés pour chaque composante chromatique, et ainsi fournir les coefficients de pondération et de dispersion de la couleur-cible, pour l'algorithme prédéterminé.

9. Appareil selon la revendication 8, dans lequel les moyens de traitement comprennent quatre tables de référence, qui définissent chacune une fonction de la forme

$$X_i = (i-Y_T)^2/N^2$$

dans laquelle Y_T est une valeur de composante de couleur-cible et N est un coefficient d'échelle choisi de telle sorte que soit atteinte la valeur voulue de sensibilité pour chaque composante chromatique, les sorties des tables de référence étant transmises à des additionneurs qui produisent la somme des sorties, la sortie des additionneurs étant transmise à une cinquième table de référence qui réduit la précision à huit bits.

Fig.1.

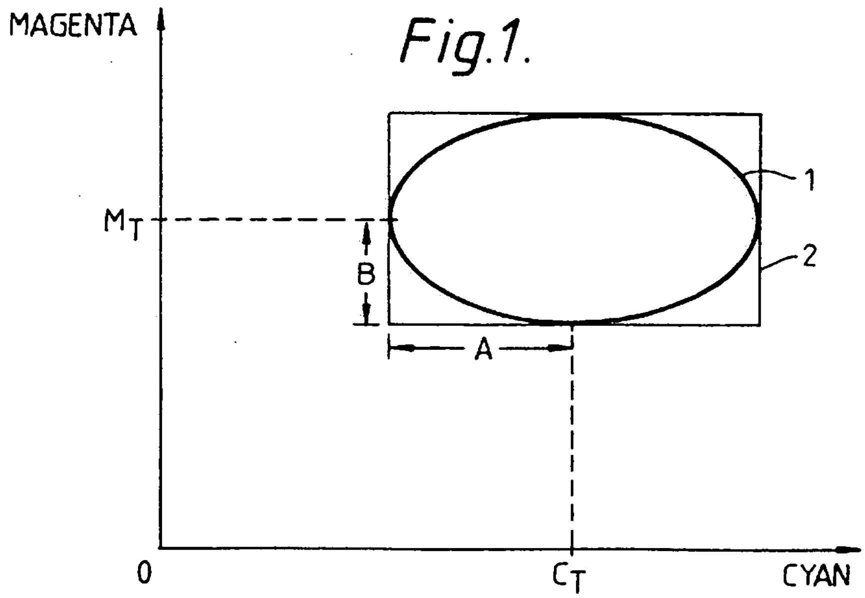


Fig. 2.

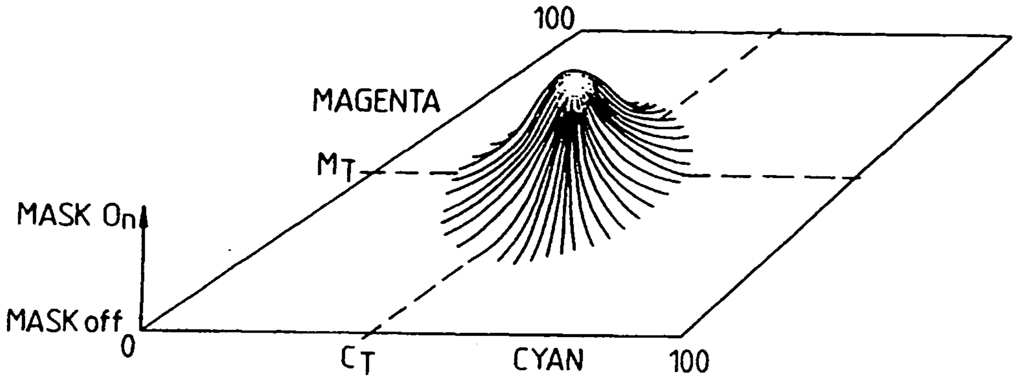

100
MAGENTA
M_T
MASK On
MASK off
0
C_T
CYAN
100

Fig. 3.

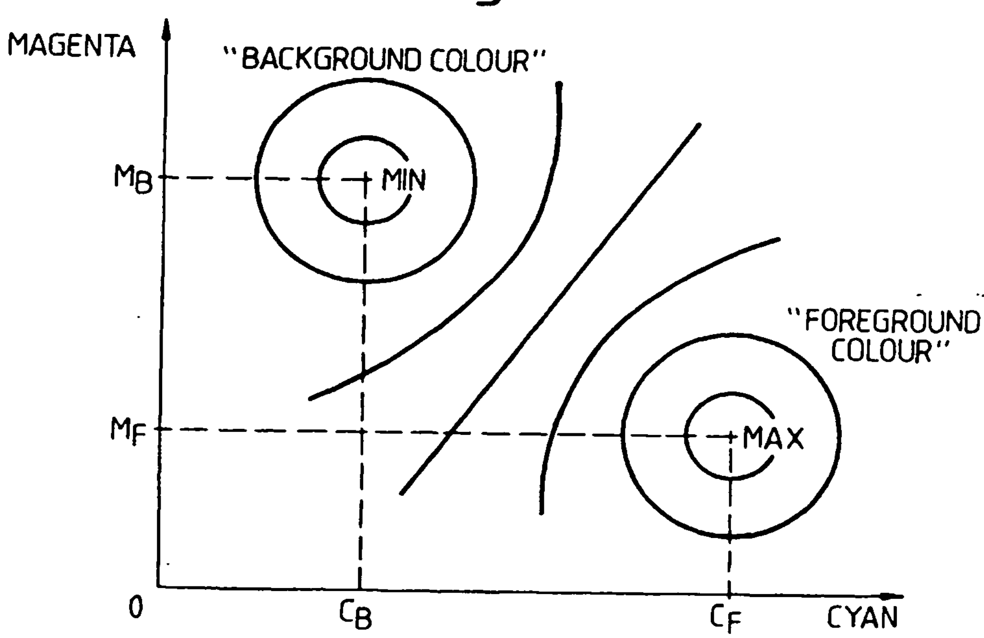

MAGENTA
"BACKGROUND COLOUR"
M_B
MIN
"FOREGROUND COLOUR"
M_F
MAX
0
C_B
C_F
CYAN

Fig.4.

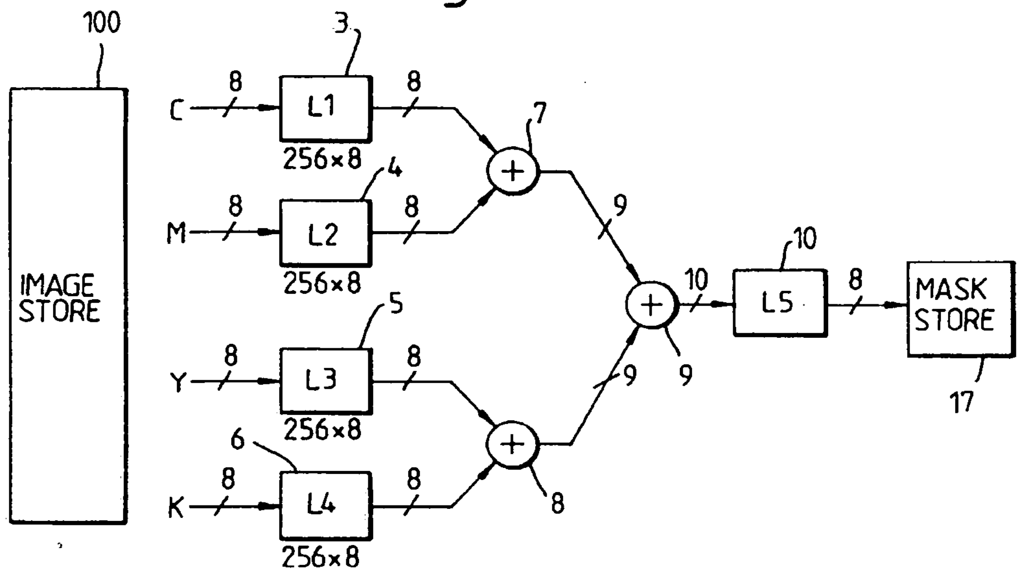

100
IMAGE STORE
C
M
Y
K
L1
L2
L3
L4
256×8
256×8
256×8
256×8
L5
MASK STORE
17

Fig.5.

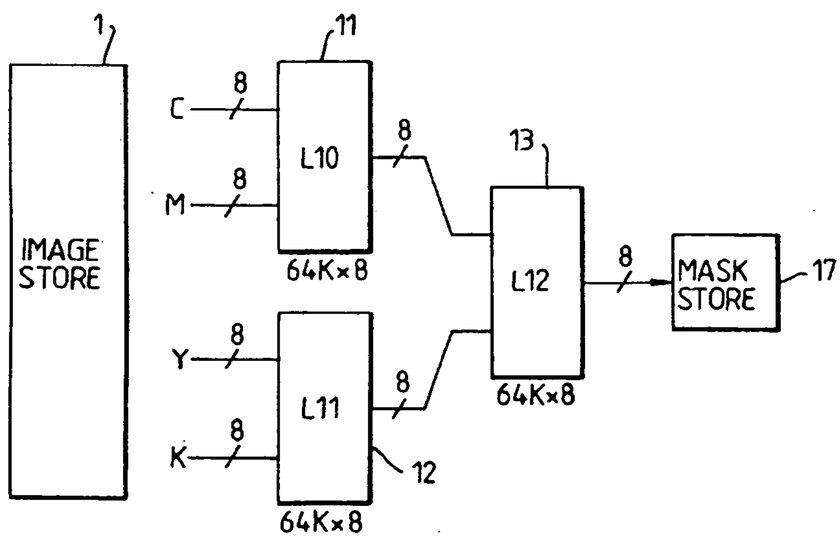
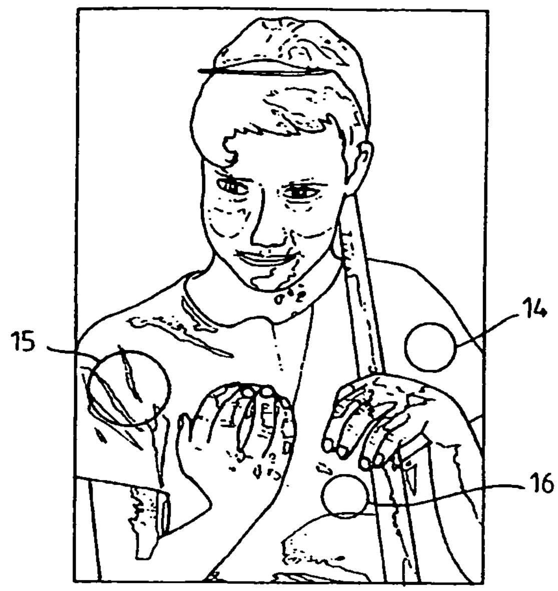

1
IMAGE STORE
C
M
Y
K
L10
L11
64K×8
64K×8
L12
64K×8
MASK STORE
17

Fig.6.

(A)


14
15
16

(B)

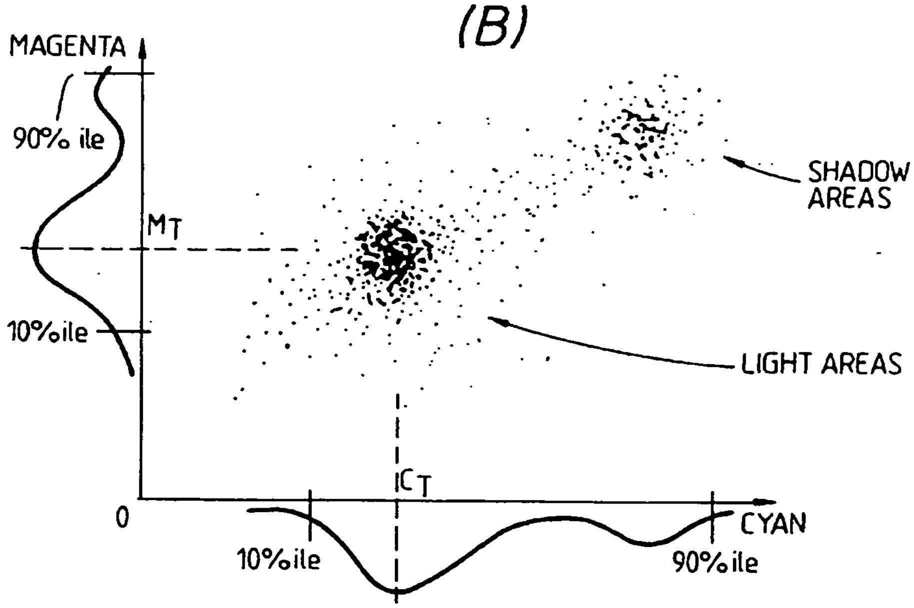
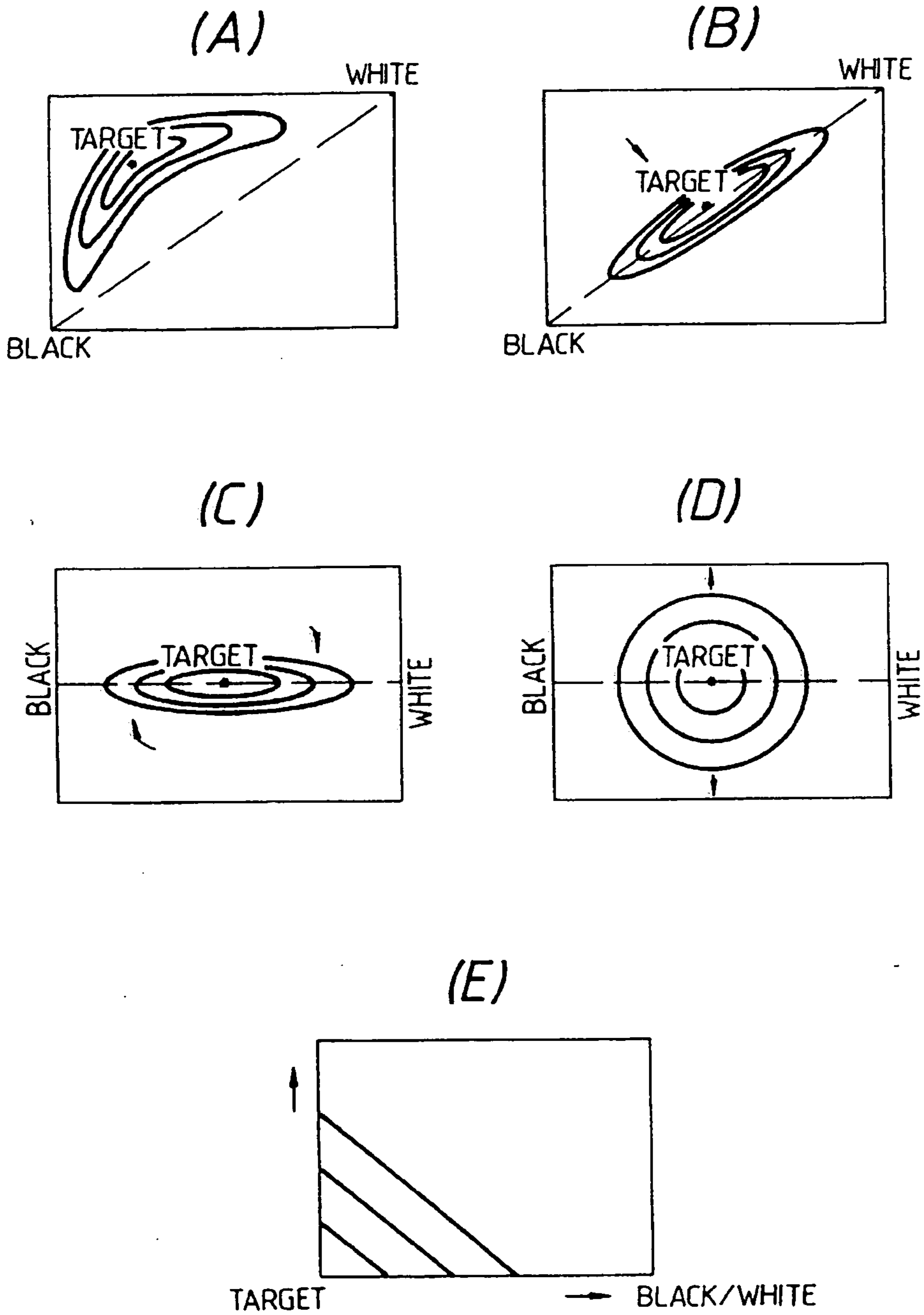

MAGENTA
90% ile
M_T
10%ile
SHADOW AREAS
LIGHT AREAS
C_T
0
10%ile
90%ile
CYAN

Fig.7.


(A)
WHITE
TARGET
BLACK
(B)
WHITE
TARGET
BLACK
(C)
TARGET
BLACK
WHITE
(D)
TARGET
BLACK
WHITE
(E)
TARGET
BLACK/WHITE

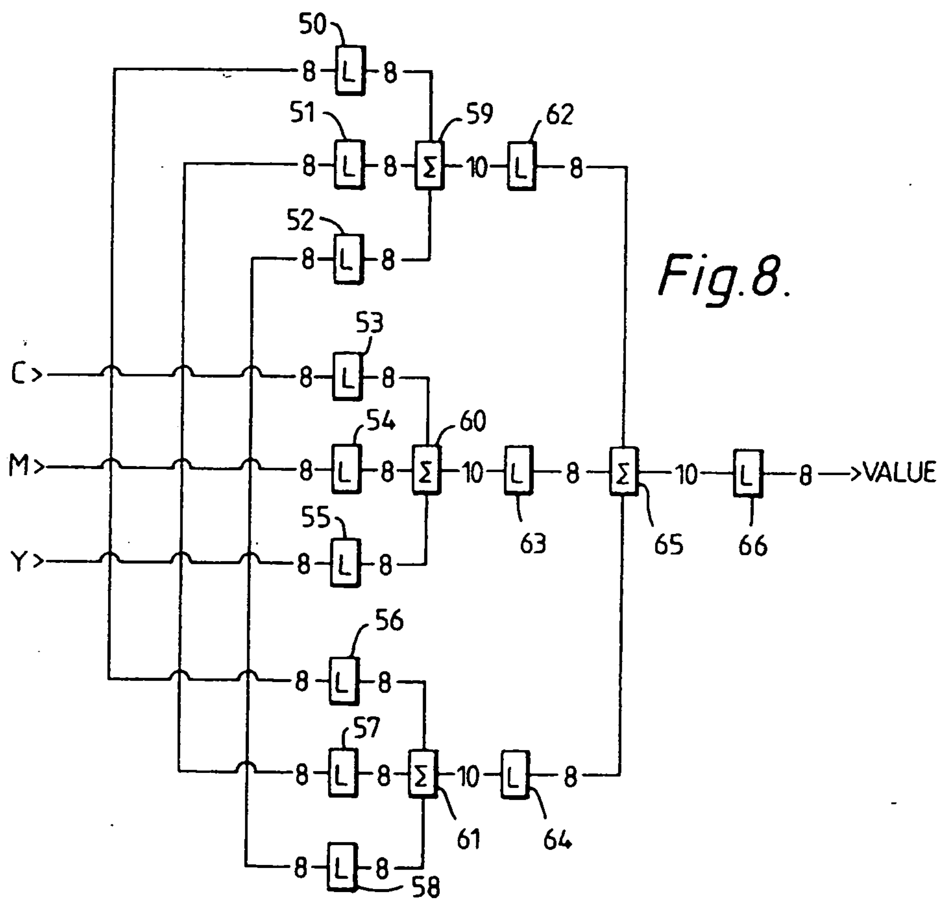


Fig.8.

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